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Huawei's power-line solution significantly improves communication in the Advanced Metering Infrastructure processing system. >>

# Enabling Interactive Electrical Grids

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The Advanced Metering Infrastructure (AMI) is a network processing system that measures, stores, analyzes, and applies consumer electricity consumption information. The AMI system includes the following:

- Smart electrical meters at user premises.
- Data management systems at power utilities.
- Communications for network interconnection.

AMI implementations provide a technical support platform for comprehensive, two-way interaction between users and the power grid by adding a digital communications return path for consumer data. Sensor networks capture measurements at circuit and device levels for efficiency and use-reduction analysis.

## Power Line Interference

Intelligent meter reading systems include the older Automatic Meter Reading (AMR) technology and the newer, two-way capable AMI systems. AMI supports real-time monitoring, remote-controlled switching, and dynamic pricing.

The AMI network platform includes the use of Power-Line Communication (PLC) and Radio Frequency (RF) for communications. Despite significant noise interference penalties that complicate network data integrity, two-way PLC technologies are deployed in 60 to 70 percent of the installed base using the existing last-mile copper distribution to minimize cost.



Unlike conventional transmission media, copper power lines were never designed to transmit digital data. High-speed, grid-signaling data transmitted over electrical power lines are subject to interference, attenuation, and loss. Typical problems include:

- Distribution transformers block power-line carriers.
- High data rates induce carrier-signal attenuation.
- Background noise degrades signal transmission.

## Significant Improvements to AMI

In Europe, the Powerline Intelligent Metering Evolution (PRIME) and G3 Alliance have adopted a new generation of anti-interference multi-carrier PLC technologies based on Orthogonal Frequency-Division Multiplexing (OFDM) that are now deployed on local and regional power grids.

Huawei has launched a patented, wideband OFDM communications circuit that integrates PLC modules with external ICT routing, switching, and security technologies.

Huawei analyzed large amounts of data from grid operators on the interference characteristics of data transport over power-line channels. The result is an anti-attenuation, anti-noise solution that optimizes signal transmission frequencies automatically for delivering fast, secure communications over power-line carriers.

The Huawei wide-band PLC Solution significantly improves AMI communication quality:

- **OFDM:** Strong anti-interference characteristics and high spectrum utilization make OFDM one of three key LTE technologies. OFDM is a parallel transmission and multi-carrier modulation method that encodes digital data on multiple carrier frequencies and will be a primary modulation method for the coming 5G era.
- **Frequency band self-adaption:** In grid communication, noise distribution varies based on changing attenuation, noise, and load conditions over time. Typically, the frequency for noise registers below 1 MHz and will

intermittently reach 2.5 MHz. Low-frequency noise reduces power amplifier efficiency by causing signals to lose energy, while high-frequency noise attenuates signals as transmission distances increase.

Huawei determined that power-line frequencies must be kept between 2 MHz and 12 MHz and coded a self-adaptation algorithm to dynamically select the ideal pass band for error-free throughput.

- **Anti-noise technology:** The Huawei wideband PLC Solution provides pulse noise detection and a clearance algorithm for time domain narrowband noise detection in the frequency domain. The solution uses multi-phase switch policies to contain the multi-phase noise produced by concentrators at the transformer stage.

Two key components enable the integration of Huawei's intelligent PLC technology into larger ICT architecture:

- **Huawei LiteOS:** A lightweight operating system designed for terminal devices on the Internet of Things (IoT), LiteOS uses plug-and-play communication modules that enable grid operators to dynamically update last-mile network communication environments based on local characteristics.
- **Huawei AR Series gateway:** Deployed between the public network and internal meter reading networks, the AR Series handles several upstream and downstream communication methods. Integrated firewalls and Virtual Private Network (VPN) functionality ensure channel and data security.

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